APPENDIX 2-H

HST ALIGNMENT AND STATION SCREENING EVALUATION SUMMARY TABLES

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Summary—HST Alignment/Station Screening Evaluation

This appendix contains the tables summarizing the comparison of alignment and station options prepared during the screening evaluation of the High-Speed Train (HST) Alternative. These screening tables present all options considered, distinguishing among the options carried forward and those eliminated from further consideration. The primary considerations for elimination are highlighted.

The HST Alternative represents the proposed action and was developed by considering a range of potential HST technologies, corridors, and within the corridors alignment and station options. Informed by previous studies and the scoping process, the California High Speed Rail Authority (Authority) and the Federal Railroad Administration (FRA) evaluated potential HST corridors and defined those that would be able to best meet the purpose of the system: *to provide a reliable mode of travel that links the major metropolitan areas of the state and delivers predictable and consistent travel times.* A further objective is, in a manner sensitive to and protective of California's unique natural resources, to provide an interface with commercial airports, mass transit, and the highway network and to relieve the capacity constraints of the existing transportation system as intercity travel demand increases in California. Through the screening process, reasonable and feasible technology, alignment and station options were identified for analysis in this Program Environmental Impact Report/Environmental Impact Statement (EIR/EIS).

HST alignment options considered were generally configured along or adjacent to existing rail transportation facilities, rather than in new corridors. While a wide range of options have been considered, the Authority's initial conceptual approach, previous corridor evaluations, and the screening evaluation conducted as part of this Program EIR/EIS have consistently shown a potential for lower environmental impacts along existing highway and rail facilities than on new alignments through both developed and undeveloped areas. Although increasing the overall width of existing facilities could have similar potential impacts on the amount of land disturbed as creating new facilities, creating new facilities would also introduce potential land use incompatibility and division or separation issues in both urban communities and rural settings (farmlands, open spaces).

Several factors were considered in identifying potential station locations. These include potential connections with other modes of transportation, ridership potential (considering the distribution of population and major destinations along the route), potential through speeds, costs, and local station access times. The ultimate locations and configurations of stations cannot be determined until the project level environmental process. The station locations described in this appendix were identified generally and represent the most likely sites based on current knowledge, consistent with the objective to serve the major population centers of the state. There would be a critical tradeoff between the accessibility of the system to potential passengers and the resulting HST travel times. The potential station locations shown are spaced approximately 50 miles (80 kilometers [km]) apart in rural areas and 15 miles (24 km) apart in the metropolitan areas. Having additional or more closely spaced stations would increase travel times and would reduce the ability to operate both express and local services, due to increased ingress/egress of trains from the mainline.

The Authority and the FRA initiated the alternatives development process in February 2000 to identify the most reasonable, feasible, and practicable HST alignment and station options for analysis in this Program EIR/EIS. The general project purpose was described early in the process and is closely related to the

general objectives and criteria for the proposed HST system set forth by the Authority with the concurrence of the FRA. Potential high-speed train corridors identified in previous studies and those identified during scoping were evaluated for their ability to meet the general project purpose and objectives. Some corridors were found not to meet the project purpose, while others were further considered through an HST alignments/stations screening evaluation to identify reasonable and practical options. This alignment and station evaluation was accomplished through the following steps.

- Review of alignment and station options identified in previous studies.
- Identification through the environmental scoping process of additional potentially feasible alignment and station options.
- Evaluation of alignment and station options using engineering, environmental, and financial criteria and evaluation methodologies (set forth in the *High-Speed Train Alignment/Station Screening Evaluation Methodology Report* [May 2001]).

Review of the ability of alignment and station options to meet general project objectives.

To simplify the evaluation of environmental impacts throughout this Program EIR/EIS, the state was divided into five geographic regions. The results of the five regional screening studies were documented in the HST alignments/stations screening evaluation. The technical data provided in the screening evaluation, combined with public and agency input, provided the Authority and the FRA with the necessary information to focus further studies for the Program EIR/EIS on a range of alignments, station locations, and HST systems that are considered practicable and were deemed likely to attain the following project objectives.

- Maximize ridership/revenue potential.
- Maximize connectivity and accessibility.
- Maximize compatibility with existing and planned development.
- Maximize avoidance of areas with geological and soils constraints.
- Maximize avoidance of areas with potential hazardous materials.
- Minimize operating and capital costs.
- Minimize impacts on natural resources.
- Minimize impacts on social and economic resources.
- Minimize impacts on cultural resources.

The results of the detailed screening evaluation are described in the *California High-Speed Train Screening Report*.

The mountain crossings for the proposed HST system would present difficult terrain and result in the need for extensive tunneling to accomplish the necessary traversing alignments. The screening evaluation of the mountain crossings was complicated by the vast potential for variation in specific alignment (horizontal and vertical) and associated differences in costs and environmental impacts. In the screening evaluation, alignment options were under consideration that could require a total of over 80 miles (129 km) of twin-tube tunneling, including the potential for continuous tunnel segments of over 30 miles (48 km) in length. Crossing the Tehachapi Mountains between Los Angeles and Bakersfield could result in 30 to 45 total miles (72 km) of tunneling in extremely challenging seismic and geologic conditions. Relative certainty and confidence in the feasibility of the proposed tunneling and associated cost estimates were of critical importance to the screening evaluation.

Given the potential for a wide range of impacts within the mountain passes, the Authority completed a review of tunneling considerations, including a two-day technical conference, and an alignment optimization and refinement study using the Quantm system to assist in the screening review.[1] Following the technical tunneling conference, the Authority developed objective criteria to minimize the amount of tunneling required, particularly the use of long tunnels (over 6 miles [10 km] in total length), due to cost, time of construction, and potential for delay. In addition, as a result of the technical conference tunnels over 12 miles (19 km) in total length are considered infeasible for this project. The crossing of major fault zones at grade was also identified as a necessary criterion. The technical information produced by the tunneling conference is documented in the *Tunneling Issues Report* (January 2003). Using the Quantm system a broad range of horizontal and vertical variations on alignment options were analyzed to provide more confidence that optimal alignments are being considered and more certainty concerning the cost estimates and potential impacts of each alignment option. The Quantm study focused on the following three objectives:

- Review the general corridors considered in the screening studies to date and/or identify any other corridors of equal or greater viability that may not have been considered in previous studies.
- Refine the alignment options in each general corridor to identify the most viable options in terms of infrastructure requirements and impact avoidance/minimization.
- Test the sensitivity of the alignment options in each corridor to key defining criteria such as vertical grade (2.5% and 3.5%), alignment geometry, infrastructure (tunnel, structure) costs, and environmental constraints.

The Quantm system identified, located, and quantified the cost of approximately 12 million alignment variations for each mountain crossing and provided a range of optimal alignments that minimized tunneling and capital costs while avoiding or minimizing potential impacts on natural resources and other sensitive areas (communities, national forests, etc.). The alignment refinement studies provided data to support the screening evaluation in the mountain passes and are documented in the *Alignment Refinement/Optimization and Evaluation of the Quantm System* (April 30, 2003).

For the HST Alternative, a number of alignment and station options, and technology options, were considered. The steel-wheel-on-steel-rail technology option was retained for further study, and the magnetic levitation technology was not recommended for the proposed HST system. There are three general reasons why alignment options were eliminated from further consideration.

- Failure to meet the general project purpose and objectives,
- Practicability constraints, and
- High potential for significant adverse environmental consequences.

For most of the alignment and station options not carried forward, failure to meet the general project purpose and objectives and practicability constraints were the primary reasons for elimination. Environmental criteria were considered a reason for elimination when an option had significantly more probable environmental impacts than other practicable options for the same segment. General project purpose and objectives were considered in terms of ridership potential, connectivity and accessibility, incompatibility with existing or planned development, or severe operational constraints. Practicability constraints were considered in terms of cost, constructability, right-of-way constraints, or other technical issues. To assess the constructability of tunnels, some specific thresholds were established to help guide the ranking. Continuous tunnel lengths of over 12 miles (19 km) were considered impracticable, and the

[1] The Quantm system is an automated route selection and optimization tool that carries out automated alignment searches and corridor screening based on client or user specified geometry, constraints, and cost parameters. While Quantm has been widely utilized in Australia, the Authority's work is the first application of this optimization system in North America.

crossing of major fault zones at grade was also identified as a necessary criterion. For other practicability considerations (e.g., right-of-way constraints, construction issues, costs) thresholds could not be established for this program-level evaluation and impracticability was determined based upon professional judgment. Environmental constraints are identified for alternatives only if they constituted primary reasons for eliminating an alternative.

A relative and comparison using qualitative indicators of potential impacts is appropriate for a screening evaluation in a program level environmental analysis, due to the broad planning decisions being considered and the substantial differences in context among different parts of the study area. The potential alignment and station options in each region that were recommended for study in the Program EIR/EIS were considered likely to be practicable and meet the general project purpose and objectives.

Screening Evaluation Criteria

Table 2-H-1 lists the objectives and criteria applied in the alignment and station options screening evaluation. The objectives and criteria built on previous studies and incorporated the HST system performance goals and criteria. Alignment and station options were considered and compared based on the established objectives and criteria. The manner in which the criteria were applied is described below.

Table 2-H-1
High-Speed Rail Alignment/Station Evaluation Objectives and Criteria

Objective	Criteria
Maximize ridership/revenue potential	Travel time Length Population/employment catchment Area
Maximize connectivity and accessibility	Intermodal connections
Minimize operating and capital costs	Length Operational issues Construction issues Capital cost Right-of-way issues/cost
Maximize compatibility with existing and planned development	Land use compatibility and conflicts Visual quality impacts
Minimize impacts on natural resources	Water resources impacts Floodplain impacts Wetland impacts Threatened and endangered species impacts
Minimize impacts on social and economic resources	Environmental justice impacts (demographics) Farmland impacts
Minimize impacts on cultural resources and parklands/wildlife refuges	Cultural resources impacts Parks and recreation impacts Wildlife refuge impacts
Maximize avoidance of areas with geologic and soils constraints	Soils/slope constraints Seismic constraints
Maximize avoidance of areas with potential hazardous materials	Hazardous materials/waste constraints

These criteria and how they were measured is described in Appendix 2-I, *Screening Evaluation Methodology and Criteria*. Some of the screening evaluation criteria focused on cost and travel time as primary indicators of engineering viability and ridership potential related to HST operations. Capital costs were estimated and travel times were quantified for each of the alignment and station options considered. Other engineering criteria such as operational, construction, and right-of-way issues were evaluated qualitatively. These engineering criteria were based on accepted engineering practices, the criteria and experiences of other railway and HST systems, and the comments of HST manufacturers as documented in the *Engineering Criteria Report* (June 2001).

The broad objectives related to the environment and the general criteria used for evaluation reflect the objectives of the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA), and are consistent with the objective of the Clean Water Act Section 404(b)(1) to provide consideration of alternatives to minimize impacts on waters of the United States. The environmental constraints and impacts criteria focused on environmental issues that can affect the location or selection of alignments and stations.

To identify potential impacts, a number of commonly available geographic information systems (GIS) digital data sources were used along with published information from federal, state, regional, and local planning documents and reports. Alignments and stations right-of-way widths dictated by engineering requirements were utilized to identify in general terms the sensitive environmental resources within each corridor segment. Potential environmental impacts were reviewed by considering areas of potential impact appropriate to the resources, and these areas varied from 100 feet to 0.5 mile, extending beyond the conceptual right-of-way for the segments. In some cases, field reconnaissance was required to view on-the-ground conditions and to provide relative values. The methods used to identify potential impacts are also described in the *High-Speed Train Alignment/Station Screening Evaluation Methodology Report* (May 2000).

Evaluation Results—Review Of High-Speed Train Corridors

Tables 2-H-2 and 2-H-3 summarize the comparison of HST alternative corridors that were evaluated during the alternatives screening process based on the consideration of available information, including data from previous studies. The tables include both the corridors that were carried forward and those that were eliminated from further consideration. The detailed technical results and description of public involvement activities and additional data that support the decision to eliminate some conceptual alternatives are contained in previously completed reports, including the Authority's final business plan (June 2000), and the corridor evaluation (December 1999), and the Commission's *Summary Report and Action Plan* (December 1996), *Corridor Evaluation and Environmental Constraints Analysis, Final Report and Appendix Volume 1* (September 1996), and the *Definition and Ranking of Potential Alignments Draft* (September 1995). These previous studies, incorporated similar system objectives, analysis methods, and evaluation criteria as used in this Program EIR/EIS. These previous corridor evaluation studies applied GIS databases and analysis methods that have been refined, updated, and applied in this Program EIR/EIS.

Table 2-H-2 compares the State Route 99 (SR-99), Interstate 5 (I-5), and Coastal corridors between San Francisco and Los Angeles. Table 2-H-3 compares the northern mountain crossings between the Bay Area and the Central Valley (Pacheco Pass, Panoche Pass and Altamont Pass). These screening tables present all factors considered distinguishing between the corridors carried forward and those eliminated from further consideration. In addition, the primary considerations for elimination are highlighted.

Evaluation Results—Review Of Alignment/Station Options

Tables 2-H-4 through 2-H-20 compare alignment and station options investigated during the screening evaluation for the five regional study areas. Within the five study areas alignment options were

considered in groups of geographically related segments. Alignment options within each segment of each region were compared and ranked on a scale from one to five (least to most favorable) based on a relative comparison of ability to meet general project purpose and objectives using measures for each criterion. The rankings were not transferable in every case to other segment comparisons.